4510

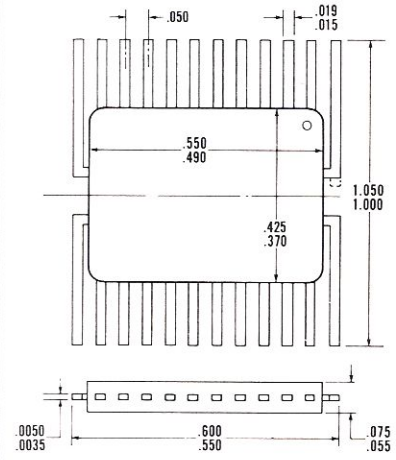
CCSL MICROMATRIX™ DUAL 4-BIT COMPARATOR

A FAIRCHILD COMPATIBLE CURRENT SINKING LOGIC PRODUCT

GENERAL DESCRIPTION — The 4510 consists of two independent 4-bit comparators useful in many decision making control applications, such as digital printers. Each comparator is capable of accepting two 4-bit inputs and provides a high level output signal when they are identical. An output latch stores the compared output when the strobe pin is high. Outputs may be "Wire ANDed" to expand comparison capability.

The circuit is produced with two layer metal interconnections using the Fairchild 4500 Bipolar Micromatrix™ Array.

24 PIN CERPAK OUTLINE



FEATURES

- **ASYNCHRONOUS AND SYNCHRONOUS OUTPUTS**
- **OPTIONAL LATCH STORAGE OF OUTPUT**
- **EXPANDABLE IN GROUPS OF 4 BITS**
- **TYPICAL POWER DISSIPATION OF 250 mW**
- **CCSL COMPATIBLE**
- **ALL CERAMIC "HERMETIC" 24 PIN CERPAK**
- **MEMBER OF 4500 MICROMATRIX™ ARRAY FAMILY**
- **TWO LAYER METAL INTERCONNECTIONS**

ABSOLUTE MAXIMUM RATINGS (above which the useful life may be impaired)

Storage Temperature	−65°C to +150°C
Temperature (Ambient) Under Bias	−55°C to +125°C
V_{CC} Pin Potential to Ground Pin	−0.5 V to +7.0 V
Voltage Applied to Output for High Output State	−0.5 V to +V_{CC} Value
Output Current Into Low Output State	20 mA
Input Voltage (D.C.)	−0.5 V to +5.5 V

ORDER INFORMATION — Specify A3M45105XX for flat package, where 5XX is 51X for −55°C to +125°C temperature range or 59X for the 0°C to +75°C temperature range.

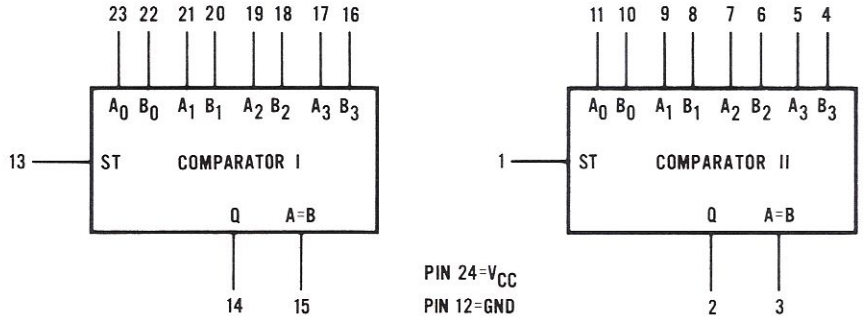


Fig. 1 — 4510 DUAL 4-BIT COMPARATOR LOGIC DIAGRAM

313 FAIRCHILD DRIVE, MOUNTAIN VIEW, CALIFORNIA, (415) 962-5011, TWX: 910-379-6435

FAIRCHILD SEMICONDUCTOR
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

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ELECTRICAL CHARACTERISTICS ($T_A = -55°C$ to $+125°C$, $V_{CC} = 5.0\ V = 10\%$)
MILITARY TEMPERATURE RANGE

SYMBOL	CHARACTERISTIC	LIMITS −55°C MIN.	LIMITS −55°C MAX.	LIMITS +25°C MIN.	LIMITS +25°C TYP.	LIMITS +25°C MAX.	LIMITS +125°C MIN.	LIMITS +125°C MAX.	UNITS	CONDITIONS
V_{OH}	Q Output High Voltage	2.6		2.6	3.4		2.5		Volts	$I_{OH} = -180\ \mu A$ { V_{IL} on any two inputs
	A = B Output High Voltage	2.6		2.6	3.4		2.5		Volts	$I_{OH} = -240\ \mu A$ { $V_{CC} = 4.5\ V$
V_{OL}	Output Low Voltage Q and A = B Output		0.4		0.22	0.4		0.4	Volts	$V_{CC} = 5.5\ V\ I_{OL} = 6.4\ mA$ { V_{ST} = GND for $V_{CC} = 4.5\ V\ I_{OL} = 5.0\ mA$ { A = B output only
	Output Low Voltage A = B Output Only		0.4		0.22	0.4		0.4	Volts	$V_{CC} = 5.5\ V\ I_{OL} = 4.8\ mA$ $V_{CC} = 4.5\ V\ I_{OL} = 3.7\ mA$ } $V_{ST} = 4\ V$
V_{IH}	Input High Voltage	2.1		1.9			1.7		Volts	Guaranteed input high threshold for all inputs
V_{IL}	Input Low Voltage		1.3			1.0		0.7	Volts	Guaranteed input low threshold for all inputs
$2\ I_F$	Input Load Current		3.2		2.36	3.2		3.2	mA	$V_{CC} = 5.5\ V$ $V_F = 0.4\ V$
			2.43		1.82	2.48		2.48	mA	$V_{CC} = 4.5\ V$ $V_F = 0.4\ V$
$1.5\ I_F$	A = B Output Load Current For "Wired AND"		2.4		1.77	2.4		2.4	mA	$V_{CC} = 5.5\ V$ { $V_F = 0.4\ V$
			1.86		1.37	1.86		1.86	mA	$V_{CC} = 4.5\ V$ { V_{ST} = GND
$2.5\ I_F$			4.0		2.95	4.0		4.0	mA	$V_{CC} = 5.5\ V$ { $V_F = 0.4\ V$
			3.1		2.28	3.1		3.1	mA	$V_{CC} = 4.5\ V$ { $V_{ST} = 4\ V$
I_R	Input Leakage Current					20		20	μA	$V_R = 4\ V$, GND on other inputs
t23+ 15+	Comparison Switching Speed				50				ns	$V_{CC} = 5\ V$
t23− 15−	A_O to A = B				50				ns	$C_L = 15\ pF$ @ Pin 15

ELECTRICAL CHARACTERISTICS ($T_A = 0°C$ to $+75°C$, $V_{CC} = 5.0\ V = 5\%$)
INDUSTRIAL TEMPERATURE RANGE

SYMBOL	CHARACTERISTIC	LIMITS 0°C MIN.	LIMITS 0°C MAX.	LIMITS +25°C MIN.	LIMITS +25°C TYP.	LIMITS +25°C MAX.	LIMITS +75°C MIN.	LIMITS +75°C MAX.	UNITS	CONDITIONS
V_{OH}	Q Output High Voltage	2.6		2.6	3.65		2.5		Volts	$I_{OH} = -180\ \mu A$ { V_{IL} on any two inputs
	A = B Output High Voltage	2.6		2.6	3.65		2.5		Volts	$I_{OH} = -300\ \mu A$ { $V_{CC} = 4.75\ V$
V_{OL}	Output Low Voltage Q and A = B Output		0.45		0.22	0.45		0.45	Volts	$V_{CC} = 5.25\ V\ I_{OL} = 8.0\ mA$ { V_{ST} = GND for $V_{CC} = 4.75\ V\ I_{OL} = 6.25\ mA$ { A = B output only
	Output Low Voltage A = B Output Only		0.45		0.22	0.45		0.45	Volts	$V_{CC} = 5.25\ V\ I_{OL} = 6.4\ mA$ $V_{CC} = 4.75\ V\ I_{OL} = 5.0\ mA$ } $V_{ST} = 4\ V$
V_{IH}	Input High Voltage	2.0		1.9			1.8		Volts	Guaranteed input high threshold for all inputs
V_{IL}	Input Low Voltage		1.1			1.0		0.8	Volts	Guaranteed input low threshold for all inputs
$2\ I_F$	Input Load Current		3.2		2.18	3.2		3.2	mA	$V_{CC} = 5.25\ V$ $V_F = 0.45\ V$
			2.82		1.92	2.82		2.82	mA	$V_{CC} = 4.75\ V$ $V_F = 0.45\ V$
$1.5\ I_F$	A = B Output Load Current For "Wired AND"		2.4		1.65	2.4		2.4	mA	$V_{CC} = 5.25\ V$ { $V_F = 0.4\ V$
			2.11		1.44	2.11		2.11	mA	$V_{CC} = 4.75\ V$ { V_{ST} = GND
$2.5\ I_F$			4.0		2.64	4.0		4.0	mA	$V_{CC} = 5.25\ V$ { $V_F = 0.4\ V$
			3.52		2.4	3.52		3.52	mA	$V_{CC} = 4.75\ V$ { $V_{ST} = 4\ V$
I_R	Input Leakage Current					20		20	μA	$V_R = 4\ V$, GND on other inputs
t23+ 15+	Comparison Switching Speed				50				ns	$V_{CC} = 5\ V$
t23− 15−	A_O to A = B				50				ns	$C_L = 15\ pF$ @ Pin 15

FUNCTIONAL DESCRIPTION

ASYNCHRONOUS — Fig. 2 shows the detailed logic representation of the comparator and latch (½ 4510). Whenever the 4-bit data word on lines A is identical to the 4-bit data word on lines B the A =B output is high. If data word A is not equal to data word B the A = B output is low.

SYNCHRONOUS — The strobe (ST) and the latch output (Q) provide storage capability of the A = B output. This function is shown in Table 1. When ST is high, Q_N equals the A = B output. When ST is low, $Q_N = Q_{N-1}$.

TABLE 1

TRANSITION TABLE FOR LATCH OUTPUT (Q)

ST	Q_N
Low	Q_{N-1}
High	A = B

DETAILED LOGIC DIAGRAM

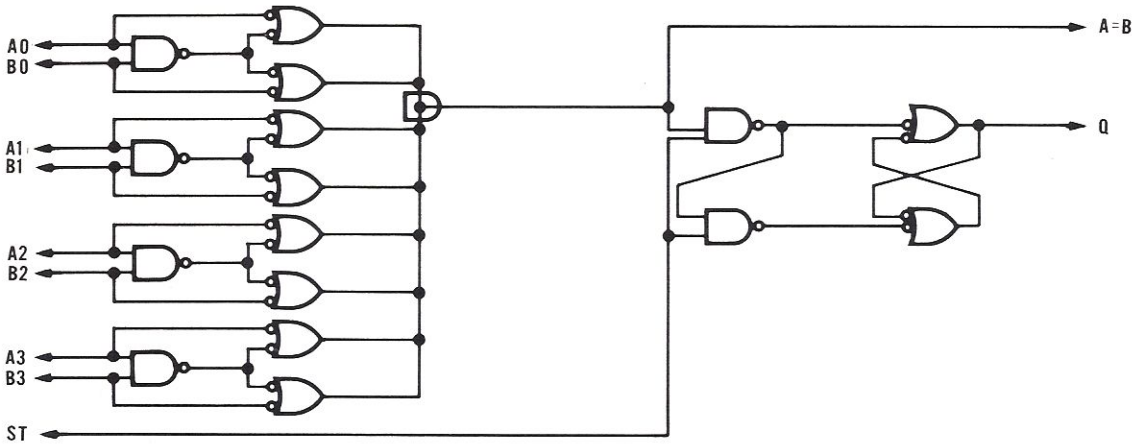
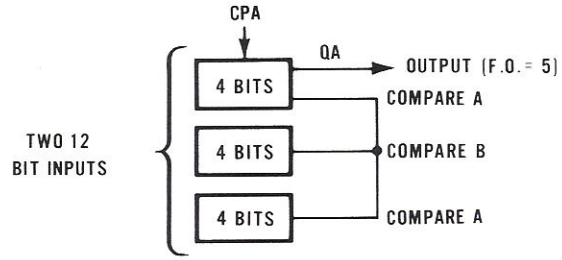


Fig. 2

SUGGESTED COMPARATOR EXPANSION METHODS



The internal "wired OR" COMPARE node uses two pull-up resistors for improved rise time, and drives an internal gate. Two COMPARE outputs may be "wire OR'd" externally to provide a 12 bit comparator as shown in Figure 3. This may be expanded further by using additional gates.

Fig. 3

4510 EQUIVALENT CIRCUITS

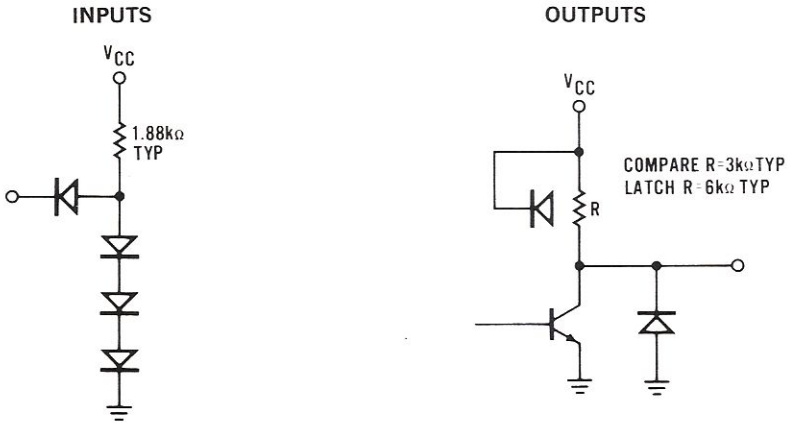


Fig. 4

LOADING RULES

INPUT LOADING RULES (FAN-IN)
DTμL UNIT LOADS

	51X	59X
Data Inputs	2.0	2.0
Strobe Inputs	2.0	2.0
"Wired AND" A = B Outputs (ST GND)	1.5	1.5
A = B Outputs (ST High)	2.5	2.5

OUTPUT DRIVE CAPABILITY (FAN-OUT)

	DTμL LOADS				TTμL LOADS			
	ST = GND		ST = HIGH		ST = GND		ST = HIGH	
	51X	59X	51X	59X	51X	59X	51X	59X
Q OUTPUT	4.0	5.0	4.0	5.0	3.0	3.0	3.0	3.0
A = B Outputs	4.0	5.0	3.0	4.0	4.0	5.0	3.0	4.0
(1) "Wired AND" 2	2.5	3.5	1.5	2.5	2.5	3.5	1.5	2.5
(1) "Wired AND" 3	1.0	2.0	0	1.0	1.0	2.0	0	1.0

(1) "Wired AND" 2 and 3 means the number of compare outputs (A = B) that are connected together. The result of this "Wired AND" connection, logically, is a high level true "AND" gate.

4-BIT COMPARATOR AND LAMP/RELAY DRIVER

One-half of a 4510 dual comparator drives a discrete driver so that when $A_0 = B_0$, $A_1 = B_1$, $A_2 = B_2$, and $A_3 = B_3$ the lamp will light or the relay operate. This circuit might also be used for a digital printer solenoid driver. The ST input is connected through a 2 kΩ resistor to V_{CC} so that Q and A = B may be paralleled for additional driver base current.

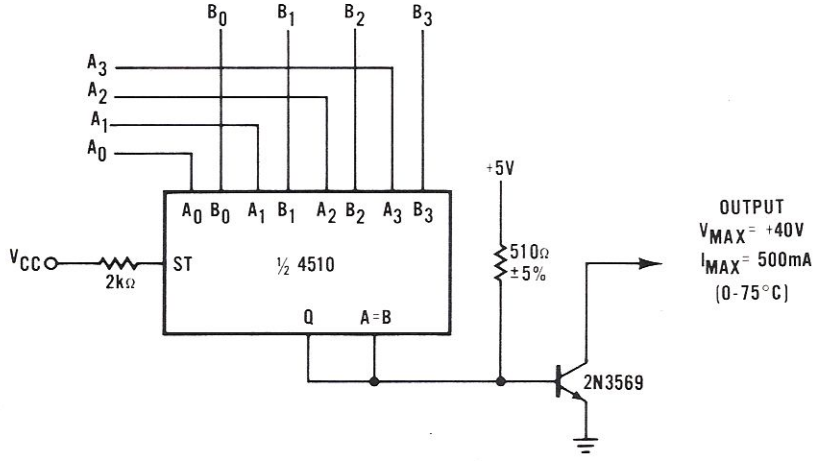


Fig. 5

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